

-28-

CLAIMS

1. A step-up/down DC-DC converter, comprising:
a voltage step-up/down part configured to generate
5 and output a predetermined output voltage by stepping up or
down an input voltage in accordance with a control signal
input to the voltage step-up/down part; and
a control part configured to generate an error
signal indicating an error between a voltage value obtained by
10 dividing the output voltage and a predetermined reference
voltage, compare the error signal and first and second
triangle wave signals, and cause the voltage step-up/down part
to perform a step-up or step-down operation based on a result
of the comparison,
15 wherein the control part includes:
a first triangle wave generator circuit
configured to generate the first triangle wave signal compared
with the error signal to determine whether to cause the
voltage step-up/down part to perform the step-down operation;
20 and
a second triangle wave generator circuit
configured to generate the second triangle wave signal
compared with the error signal to determine whether to cause
the voltage step-up/down part to perform the step-up operation,
25 the first triangle wave generator circuit

-29-

being configured to generate a clock signal synchronized with the generated first triangle wave signal, and output the generated clock signal to the second triangle wave generator circuit,

5 the second triangle wave generator circuit being configured to generate the second triangle wave signal synchronized with the first triangle wave signal based on the input clock signal, and output the second triangle wave signal.

10 2. The step-up/down DC-DC converter as claimed in claim 1, wherein the control part further comprises:

 a first voltage generator circuit configured to generate and output a first voltage V_a for setting a lower limit voltage of the first triangle wave signal;

15 a second voltage generator circuit configured to generate and output a second voltage V_b for setting an upper limit voltage of the first triangle wave signal;

 a third voltage generator circuit configured to generate and output a third voltage V_c for setting an upper
20 limit voltage of the second triangle wave signal; and

 a current generator circuit configured to generate and output a current setting a slope of voltage variation of each of the first and second triangle wave signals,

 the first triangle wave generator circuit being
25 configured to generate the first triangle wave signal from the

-30-

first and second voltages V_a and V_b and the current output from the current generator circuit,

the second triangle wave generator circuit being configured to generate the second triangle wave signal from the third voltage V_c , the current output from the current generator circuit, and the clock signal output from the first triangle wave generator circuit.

3. The step-up/down DC-DC converter as claimed in claim 2, wherein the first, second, and third voltage generator circuits are configured to generate and output the corresponding first, second, and third voltages V_a , V_b , and V_c so that the first, second, and third voltages V_a , V_b , and V_c satisfy $V_a < V_b < V_c$ and $(V_b - V_a) > (V_c - V_b)$.

15

4. The step-up/down DC-DC converter as claimed in claim 2, wherein the second triangle wave generator circuit is configured to decrease a voltage of the second triangle wave signal when the voltage of the second triangle wave signal reaches the third voltage V_c , and increase the voltage of the second triangle wave signal in synchronization with the clock signal.

5. The step-up/down DC-DC converter as claimed in claim 2, wherein each of the first, second, and third voltage

25

-31-

generator circuits is configured to generate a corresponding one of the first, second, and third voltages V_a , V_b , and V_c by dividing a predetermined voltage by resistors.

5 6. The step-up/down DC-DC converter as claimed in claim 1, wherein the first triangle wave generator circuit is configured to synchronize the clock signal with a lower limit voltage of the first triangle wave signal.

10 7. A step-up/down DC-DC converter, comprising:
a voltage step-up/down part configured to generate and output a predetermined output voltage by stepping up or down an input voltage in accordance with a control signal input to the voltage step-up/down part; and
15 a control part configured to generate an error signal indicating an error between a voltage value obtained by dividing the output voltage and a predetermined reference voltage, compare the error signal and first and second triangle wave signals, and cause the voltage step-up/down part
20 to perform a step-up or step-down operation based on a result of the comparison,

wherein the control part includes:

a first triangle wave generator circuit
configured to generate the first triangle wave signal compared
25 with the error signal to determine whether to cause the

-32-

voltage step-up/down part to perform the step-down operation;
and

a second triangle wave generator circuit
configured to generate the second triangle wave signal

5 compared with the error signal to determine whether to cause
the voltage step-up/down part to perform the step-up operation,

the second triangle wave generator circuit
being configured to generate a clock signal synchronized with
the generated second triangle wave signal, and output the
10 generated clock signal to the first triangle wave generator
circuit,

the first triangle wave generator circuit
being configured to generate the first triangle wave signal
synchronized with the second triangle wave signal based on the
15 input clock signal, and output the first triangle wave signal.

8. The step-up/down DC-DC converter as claimed in
claim 7, wherein the control part further comprises:

a first voltage generator circuit configured to
20 generate and output a first voltage V_a for setting a lower
limit voltage of the first triangle wave signal;

a second voltage generator circuit configured to
generate and output a second voltage V_b for setting a lower
limit voltage of the second triangle wave signal;

25 a third voltage generator circuit configured to

-33-

generate and output a third voltage V_c for setting an upper limit voltage of the second triangle wave signal; and

a current generator circuit configured to generate and output a current setting a slope of voltage variation of
5 each of the first and second triangle wave signals,

the first triangle wave generator circuit being configured to generate the first triangle wave signal from the first voltage V_a , the current output from the current generator circuit, and the clock signal output from the second
10 triangle wave generator circuit,

the second triangle wave generator circuit being configured to generate the second triangle wave signal from the second and third voltages V_b and V_c and the current output from the current generator circuit.

15

9. The step-up/down DC-DC converter as claimed in claim 8, wherein the first, second, and third voltage generator circuits are configured to generate and output the corresponding first, second, and third voltages V_a , V_b , and V_c
20 so that the first, second, and third voltages V_a , V_b , and V_c satisfy $V_a < V_b < V_c$ and $(V_b - V_a) < (V_c - V_b)$.

10. The step-up/down DC-DC converter as claimed in claim 8, wherein the first triangle wave generator circuit is
25 configured to increase a voltage of the first triangle wave

-34-

signal when the voltage of the first triangle wave signal reaches the first voltage V_a , and decrease the voltage of the first triangle wave signal in synchronization with the clock signal.

5

11. The step-up/down DC-DC converter as claimed in claim 8, wherein each of the first, second, and third voltage generator circuits is configured to generate a corresponding one of the first, second, and third voltages V_a , V_b , and V_c by
10 dividing a predetermined voltage by resistors.

12. The step-up/down DC-DC converter as claimed in claim 7, wherein the second triangle wave generator circuit is configured to synchronize the clock signal with an upper limit
15 voltage of the second triangle wave signal.

13. A step-up/down DC-DC converter, comprising:
a voltage step-up/down part configured to generate and output a predetermined output voltage by stepping up or
20 down an input voltage in accordance with a control signal input to the voltage step-up/down part; and

a control part configured to generate an error signal indicating an error between a voltage value obtained by dividing the output voltage and a predetermined reference
25 voltage, compare the error signal and first and second

-35-

triangle wave signals, and cause the voltage step-up/down part to perform a step-up or step-down operation based on a result of the comparison,

wherein the control part includes:

5 first triangle wave generator means for generating the first triangle wave signal compared with the error signal to determine whether to cause the voltage step-up/down part to perform the step-down operation; and

 second triangle wave generator means for
10 generating the second triangle wave signal compared with the error signal to determine whether to cause the voltage step-up/down part to perform the step-up operation,

 the first triangle wave generator means generating a clock signal synchronized with the generated
15 first triangle wave signal, and outputting the generated clock signal to the second triangle wave generator means,

 the second triangle wave generator means generating the second triangle wave signal synchronized with the first triangle wave signal based on the input clock signal,
20 and outputting the second triangle wave signal.

14. A step-up/down DC-DC converter, comprising:

 a voltage step-up/down part configured to generate and output a predetermined output voltage by stepping up or
25 down an input voltage in accordance with a control signal

-36-

input to the voltage step-up/down part; and

a control part configured to generate an error signal indicating an error between a voltage value obtained by dividing the output voltage and a predetermined reference

5 voltage, compare the error signal and first and second triangle wave signals, and cause the voltage step-up/down part to perform a step-up or step-down operation based on a result of the comparison,

wherein the control part includes:

10 first triangle wave generator means for generating the first triangle wave signal compared with the error signal to determine whether to cause the voltage step-up/down part to perform the step-down operation; and

second triangle wave generator means for
15 generating the second triangle wave signal compared with the error signal to determine whether to cause the voltage step-up/down part to perform the step-up operation,

the second triangle wave generator means
generating a clock signal synchronized with the generated
20 second triangle wave signal, and outputting the generated clock signal to the first triangle wave generator means,

the first triangle wave generator means
generating the first triangle wave signal synchronized with
the second triangle wave signal based on the input clock
25 signal, and outputting the first triangle wave signal.